

ELT. The 1st time period (between merge and when the mission is opened) is the true "planning/evaluation" period, and can be greatly reduced when 406 MHz ELTs are used. From the analysis of AFRCC mission folders it was determined that the average time from "merge" to "mission opened" was **3.9 hours**. Figure 4-3 shows the distribution of this time period.

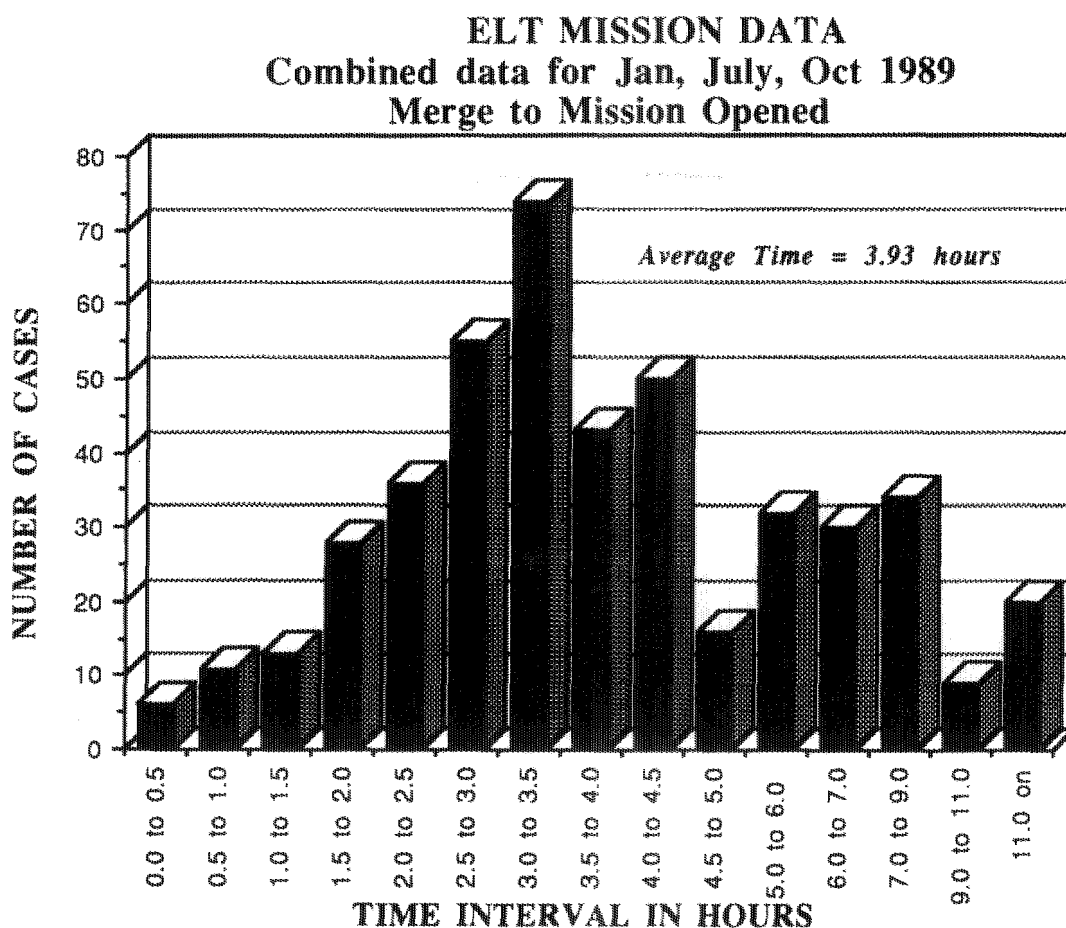


FIGURE 4-3

This time is spent primarily in communications checks to attempt to determine if the "distress location" is from a real ELT or EPIRB and if a real emergency exists. The effort involves numerous cross checks with FAA to obtain overflying aircraft reports and with airports in the vicinity to attempt to isolate the location of the transmitter. This extensive cross checking with a number of sources is necessitated by the large number of "false

alerts"¹² and false alarms¹³, as well as the fact that the location accuracy obtained from 121.5/243 MHz ELTs can include a number of airports within a broad area, all of which have to be checked for false alarms.

It appears reasonable to assume that because of the need to make fewer calls due to the increased accuracy from 406 MHz and the knowledge that the alert is from an ELT transmission (noise and other signals screened out with I.D.) the time required to launch a mission can be reduced to within an hour, thus providing a **saving in the timeline of approximately 2.9 hours.**

4.2.3 Search Stage

Data from the AFRCC mission folders indicates that an average of 2.2 hours is spent in the search area in 121.5/243 MHz ELT missions. Figure 4-4 shows a histogram of the data from the 3 months of AFRCC mission folders. Whereas it may not be reasonable to reduce this time by a factor of ten as indicated by the reduction of the 406 MHz search area (see discussion in paragraph 3.3), discussions with CAP personnel who have conducted ELT searches lead us to conclude that .5 hours would appear to be conservative for the time required to locate a 406 MHz ELT, given the accuracy of location available. **This assumption would mean a reduction of 1.7 hours in the 406 MHz timeline vice the 121.5/243 MHz.**

¹² A "false alert" is a location generated by the COSPAS-SARSAT system from other than distress transmitters. They are generated by other RF signals in the band or from noise. False alarms are signals from non-distress situations which are radiated by a distress transmitter

¹³ A "false alarm" is when an actual ELT or EPIRB is transmitting in a non-distress situation.

ELT MISSION DATA
Combined data for Jan, July, Oct
Hours in search area

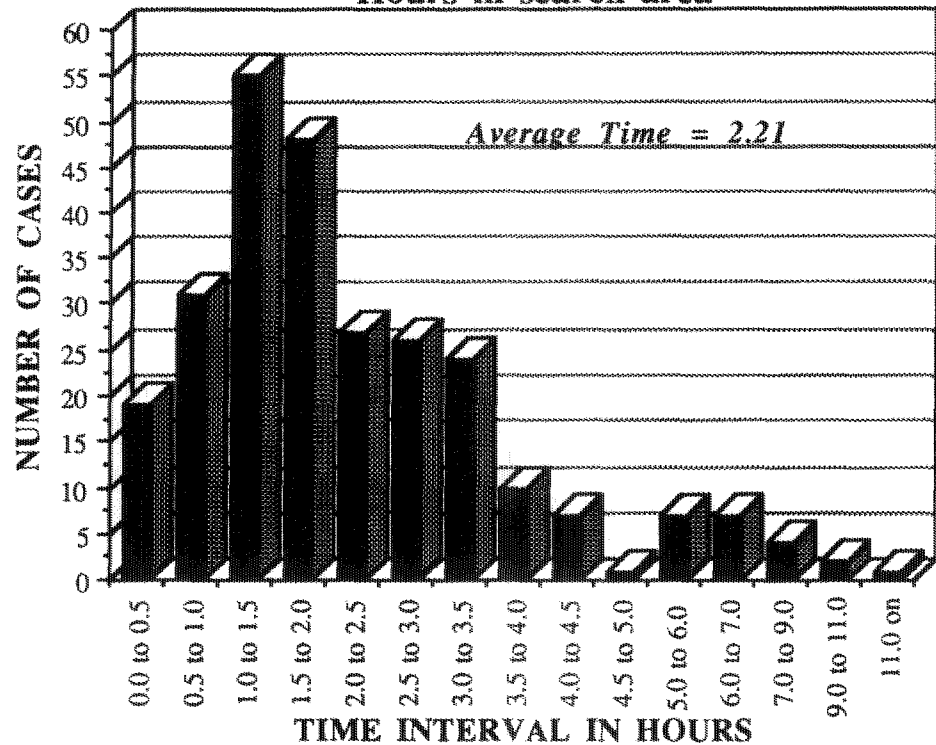


FIGURE 4-4

4.2.4 Total Timeline Reduction

The reduction in the SAR timeline can be estimated by two methods: the addition of the time savings in each phase of the rescue timeline; or the comparison on a ratio basis with US Coast Guard experience in handling 406 MHz alerts.

1st Method

From adding the estimated time saved in each phase of the SAR mission, **the total time saved is 6.4 hours**, derived as follows:

Saving from 1st Alert to Merge	1.8 hours
Saving in Mission Planning	2.9 hours
Saving in Search time	<u>1.7 hours</u>
TOTAL	6.4 hours

2nd Method

Experience by the US Coast Guard with 406 MHz EPIRBs shows a dramatic improvement in the time between the SARSAT alert and when a mission is opened. In the case of the 121.5/243 MHz alerts the average time taken to open a mission (from 1st alert) is 2.69 hours. For 406 MHz the time required is .35 hours. There has been no experience at the AFRCC with handling of 406 MHz alerts, however, it seems reasonable that the ratio of times required to open a mission for 121.5/243 MHz distresses vice 406 MHz should be about the same (E.g. $2.7/.6 = 5.8/Tx$).¹⁴ Based upon this rationale the time to open a 406 MHz mission at the AFRCC is projected at 1.3 hours or a saving in the timeline between 1st alert and mission opened of 4.4 hours. (This includes the time saved from 1st alert to merge.) **The total timeline reduction by this method of estimation is the 4.4 hours plus the 1.7 hour saving in search time for a total of 6.1 hours.**

Based upon the above analysis it appears reasonable to assume that the 406 MHz system will save 6.1 hours from the average mission timeline experienced today with 121.5 MHz ELTs.

4.2.4 Geostationary Alerts

Reduction in the SAR timeline can be expected in many cases when the alert is received through a geostationary satellite. Operational experience in Canada and in the US maritime area has shown that when the 406 MHz beacon has been registered in the I.D. data base a dramatic reduction results in locating the site of the distress, whether it is a real distress or a false alarm. This results because the I.D. data base contains points of contact (owner, marina, airport etc.) which allow the RCC to take immediate action in locating and identifying the validity of the alert. This action can be taken without waiting for the low orbiting COSPAS/SARSAT satellites to provide reception of the signal. Since the average waiting time in the US is approximately 1.8 hours, it is estimated that this would save an additional hour from the timeline.

¹⁴ Tx is the estimated time it would take for the AFRCC to open a mission after the first alert is received using the 406 MHz ELT.

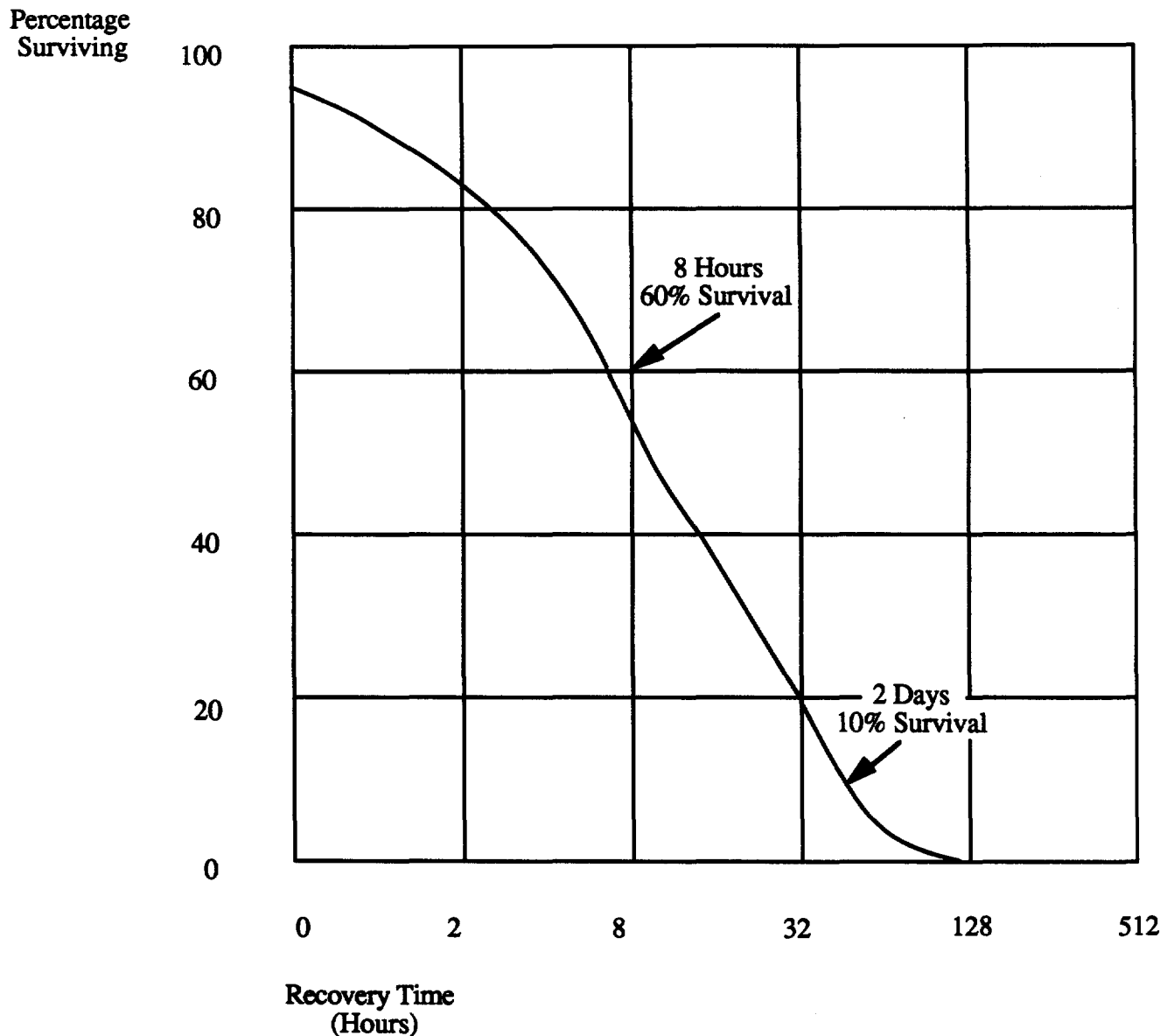
4.2.5 Approach to Deriving Benefits from SAR Mission Timeline Reduction

Figure 4-5 shows a typical Survival versus Time curve which was drawn from data presented in a DOT study¹⁵. Figure 4-6 shows a curve based upon actual data from NTSB accident reports¹⁶ superimposed on Figure 4-5. Since the slope of this "curve" of actual data is much less than the curve in the DOT report it is felt to be a conservative approach in estimating the survivability versus time for the 406 MHz ELT distress cases. The improved survivability of 40% (vice 34% when 121.5 MHz ELTs are used; indicates an improvement in survivability of 6%) is derived from a reduction in the timeline (6.1 hours due to the advantages of the 406 MHz ELT) and projecting the new average time to rescue on the "survival time" curve to the new "Percentage Surviving" value. In those cases where a geostationary alert is received, and the beacon is registered in the I.D, data base, the estimate of survivability is 43% (for an additional increase in survivability of 3%).

¹⁵ DOD & NSC data given in C. Mundo, L. Tami & G. Larson, Final Report Program Plan for Search & Rescue Electronics Alerting and Locating System, DOT-TSC-73-42, February 1974.

¹⁶ NASA Contractor Report 4330 entitled "Current Emergency Locator Transmitter (ELT) Deficiencies and Potential Improvements Utilizing TSO-C91a ELTs", October 1990

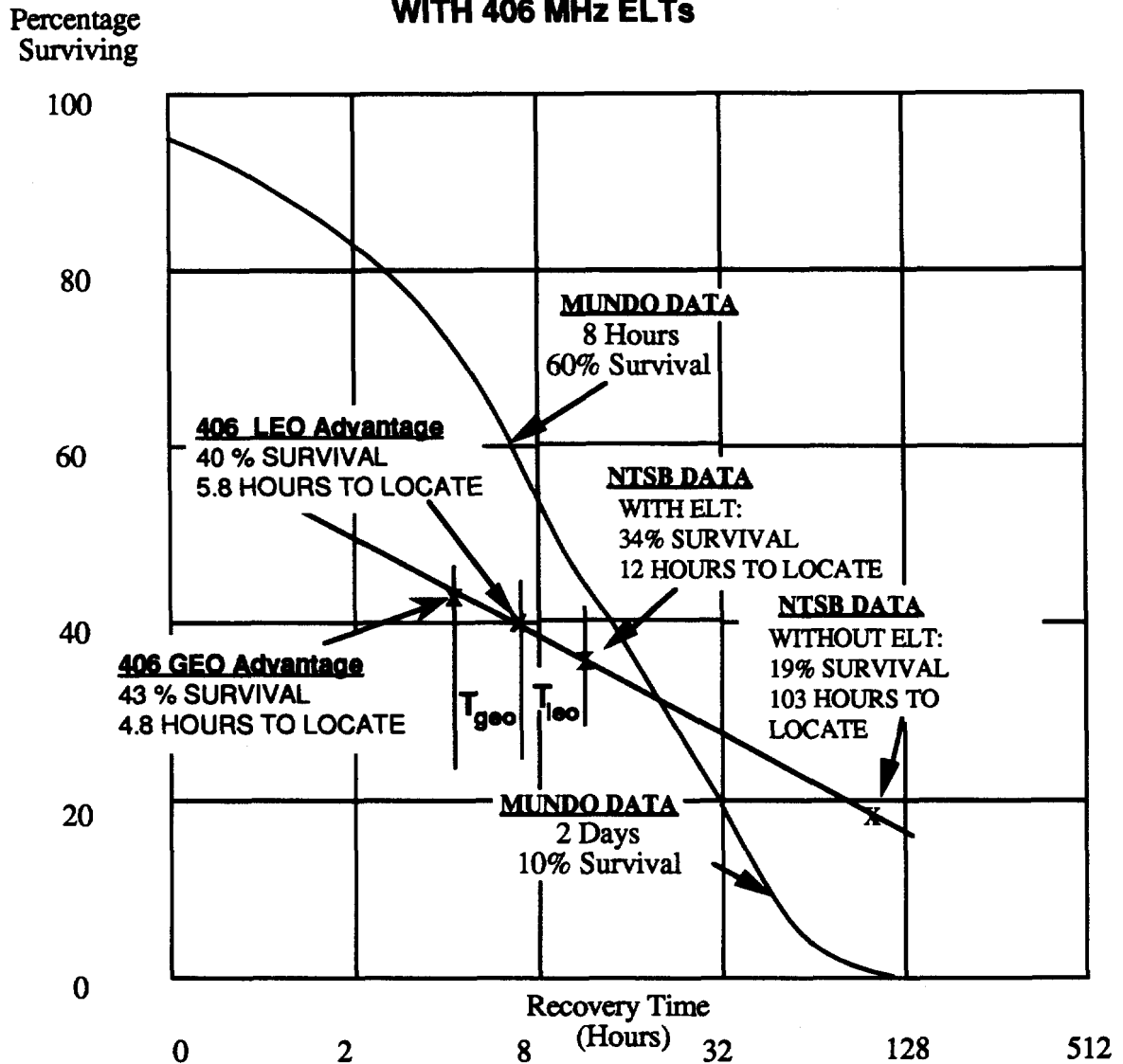
FIGURE 4-5
SURVIVAL AS A FUNCTION OF RECOVERY TIME



REF: Final Report ICSAR Ad Hoc Working Group Report on Satellites for Distress Alerting and Locating.
Oct. 1976, pg. 6-15.

DOD & NSC data given in C. Mundo, L. Tami & G. Larson,
Final Report Program Plan for Search & Rescue Electronics Alerting and Locating System.
DOT-TSC-OST-73-42, February 1974.

**FIGURE 4-6
SURVIVABILITY ADVANTAGE
WITH 406 MHz ELTs**



T_{leo} = Timeline saving due to use of
406 MHz ELTs = 6.1 hrs using
COSPAS-SARSAT LEO system

T_{geo} = Timeline saving due to use of
406 MHz ELTs = 7.1 hrs using
406 MHz GEO system.

REF: Final Report ICSAR Ad Hoc Working Group Report on Satellites for Distress Alerting and Locating.
Oct. 1976, pg. 6-15.

DOD & NSC data given in C. Mundo, L. Tami & G. Larson,
Final Report Program Plan for Search & Rescue Electronics Alerting and Locating System.
DOT-TSC-OST-73-42, February 1974.

4.3 REDUCTION OF RESOURCES FOR HANDLING FALSE ALARMS

To simplify the analysis of the savings to be made in this area it was assumed that the number of false alarms would remain unchanged from present operational experience. It is felt that this is a conservative assumption, but it is partly necessitated by the fact that there is no basis on which to determine false alarm reduction from either the TSO-C91a ELTs or the 406 MHz ELTs, since no field experience exists. As discussed in Chapter 3, there are many features of the 406 MHz system which will improve SAR operations. A number of these features will not only improve SAR operations in distress cases, but they will also help to prevent and/or mitigate the problems of false alerts and false alarms. The false alerts will be eliminated due to the coding of the message.¹⁷ In addition, problems with false alarms will be mitigated due to the greater ease of handling the 406 MHz alerts. The features in the 406 MHz system which will lead to mitigation of false alarms are:

- 1) Identification in the Message and
- 2) the Accuracy of Location.

4.3.1 Identification in the Message

Identification in the message will allow the RCC controllers to know the type of vehicle (e.g. aircraft or ship) and when the I.D. is registered in the data base will allow communications checks with the owner, home airport or other points of contact to determine if an emergency exists. The registry will also show the type of aircraft and give an indication of the number of people that may be involved such as in an airliner or a small private plane.

4.3.2 Accuracy of Location

The accuracy of location (within approximately 2 Km) will be of particular help when the data base information is not available or in error. This accuracy should allow the RCC to contact the particular airport, if the plane is on an airport, or send someone directly to the scene.

4.3.3 U.S. Coast Guard Experience with 406 MHz EPIRB False Alarms

The U.S. Coast Guard experience with 406 MHz EPIRBs validates the above assumptions on the mitigation of false alarms. When the EPIRB is registered in the data base more than 80% of the false alarms are handled without launching a mission.

¹⁷ Identification as a distress message is required for the COSPAS-SARSAT system to accept the message, therefore R.F. signals from other sources will not be treated as an alert.

4.3.4 Assumptions for Saving Resources in Handling ELT False Alarms

If we assume that registration in the inland area for 406 MHz ELTs will be 50% successful¹⁸ and the Coast Guard experience at silencing false alarms (80% silenced without launching a mission) will be similar in the inland area, we have a basis of forecasting the saving due to using the 406 MHz ELTs. In addition to eliminating 40% of the missions (50% registered times 80% silenced without mission), the cost of the remaining false alarm missions will be reduced by the timeline saving discussed in paragraph 4.2. The saving of resources from improved handling of false alarms with the 406 MHz system results in a reduction of resources by 40% (due to elimination of missions) plus approximately 1/4 of the resources for the remaining false alarm missions, for a total reduction of 55% of the current resources used for the mitigation of false alarms.

5 STUDY RESULTS

As discussed in Chapter 4, the benefits to be obtained from the use of 406 MHz ELTs will be derived from three areas: 1) improved survivability; 2) reduction in the SAR timeline; and 3) improved handling of false alarms.

5.1 Benefit from improved Survivability

Paragraph 4.1 discussed the improved survivability of the 406 MHz ELT (81%) vice the TSO-C91a ELT (73%) which will translate to additional lives saved per year if 406 MHz ELTs were in general use. To accomplish this translation the results contained in Chapter VII of the NASA study were used as a basis. In the NASA study it was projected that approximately 25 lives per year could be saved (page 29) using TSO-C91a ELTs. Since the projected success rate for TSO-C91a ELTs was shown to have the potential for saving approximately 25 lives per year, the 406 MHz ELTs should have the potential for saving an additional 3 lives per year based upon a straight ratioing of the data.¹⁹

5.2 Benefit from Reduction in the SAR Timeline

Paragraph 4.2 developed the rationale for reducing the average SAR timeline using the operational performance advantages of the 406 MHz system. It was shown that 6.1 hours could be saved using the COSPAS-SARSAT 406 MHz LEO system and an

¹⁸ Current experience with 406 MHz EPIRBs

¹⁹ $73\%/25 \text{ lives} = 81\%/X$, where X is 28 lives per year, or an additional 3 lives per year.

additional hour could be saved using the 406 MHz geostationary (GEO) system. This time saving was projected on the survival rate versus time to rescue curve and the result was shown to be an increase to 40% survivability **(an increase of 6% over the 121.5/243 MHz TSO-C91a ELTs)** with the 406 MHz LEO system and 43% **(an additional increase of 3%)** with the GEO system. By examining Table 14 from the NASA report the benefits from the increased survivability of the 406 MHz can be developed. This data has been added to the bottom of Table 14 from the NASA report and is given in Table 5-1 below. The data shows that an additional **6 lives per year can be saved using 406 MHz ELTs** with the LEO system and **3 more lives per year** with the GEO system if all 406 MHz ELTs were registered in the I.D. data base.

TABLE 5-1

**NTSB Survivor Data
When a Search was Required
(1 January 1983 through 17 October 1988)
from NASA Report, Table 14
With Added Benefits From 406 MHz ELTs**

	# of Accidents	# People Involved	# of Survivors	Survival Rate
A. Accidents where ELT was operating	255	648	222	34%
B. Accidents where ELT was not operating	407	928	179	19%
<p align="center">Survivability Advantage When ELT is Operating $34\% - 19\% =$ 15%</p> <p align="center">Lives lost from 1983 through 17 October 1988 due to ELT not operating $15\% \times 928 \text{ people involved} =$ 139 LIVES</p> <p align="center">Number of lives lost per year due to ELT failure $139 / 6 \text{ years} =$ 23 LIVES / YEAR</p>				
<p align="center">406 MHz ELT Survivability Advantage over 121.5/243 MHz ELTs $40\% - 34\% = 6\%$</p>				
<p align="center">Potential Lives to be Saved with 406 MHz LEOSystem $6\% \times 648 \text{ people involved} =$ 39 lives in 6 years or <u>6 lives per year</u></p>				
<p align="center"><u>Additional Benefit from 406 MHz GEO System</u> $3\% \times 648 = 19 \text{ lives or}$ <u>3 additional lives per year</u></p>				

5.3 Benefits From Improved Handling of False Alarms

Paragraph 4.3 discussed the reduction of resources that could be expected from the use of 406 MHz ELTs due to the increase in efficiency in handling these false alarms. It was estimated that 40% of the false alarms currently requiring missions would be resolved without opening a mission and that another 15% of resources would be saved by reducing the timeline of 406 MHz false alarm missions. Using cost data provided by the Scott Air Force Base RCC it was estimated that approximately \$10 Million is spent each year on ELT missions. (See Appendix B for derivation of this estimate.) Since 97% of the ELT missions are determined to be false alarms then 97% of \$10 million or \$9.7 million is expended on the mitigation of 121.5/243 MHz false alarms.

Using the reduction in resources estimated in paragraph 4.3.4 (55%) the increased efficiency of the 406 MHz system should result in a **total annual saving of \$5.4 million** on the assumption that the false alarms from 406 MHz ELTs would remain at the same level as the current 121.5/243 MHz ELTs. This is felt to be a conservative assumption due to features in the 406 MHz ELT (e.g. self test) which should reduce the overall number of false alarms.

6.0 CONCLUSIONS & SUMMARY OF POTENTIAL BENEFITS

The saving of lives that can be expected from the use of 406 MHz ELTs vice the TSO-C91a 121.5/243 MHz ELTs have been derived in Section 5 above and are shown to be due to both an expected improvement in survivability of the 406 MHz ELTs (See Table 4-1) and the reduction in the search and rescue timeline due to the improved operational capability of the 406 MHz satellite system (See Figure 4-6). The additional benefit from the use of 406 MHz ELTs results from the improved efficiency of handling false alarms resulting in operational cost savings. In summary the replacement of all 121.5/243 MHz ELTs with 406 MHz ELTs is projected to provide the following benefits:

**9 lives per year and a saving of
\$5.4 million**

APPENDIX A

**COMPARISON OF
ELT PERFORMANCE SPECIFICATIONS**

**RTCA DO-183 (121.5/243 MHz ELTs)
and
RTCA DO-204 (406 MHz ELTs)**

ELT PERFORMANCE SPECIFICATIONS

(RTCA/DO-183, RTCA/DO-204 COMPARISON)

A. PERFORMANCE REQUIREMENTS

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F. ¹	COMMENTS
1. Operating Life	<p>Para 2.2.1 Reference 2.2.2.5 & 2.3.1 Requires a power supply capacity to provide continuous operation between -20° C and $+55^{\circ}$ C. ELT should operate for a 50 hr. period with a minimum PERP of 50 mW (17 dBm) or operate for a 100 hr. period with a minimum PERP of 25 mW (14 dBm). Additionally, ELT may be qualified to operate throughout a 50 hr. period at -40° C with a minimum PERP of 5 mW (7 dBm).</p>	<p>Para 2.2.1 Requires a minimum operational duration of 24 hours.</p>	0	<p>406 MHz ELT will be used in conjunction with a 121.5/243.0 ELT. The satellite system will normally detect and locate a 406 MHz signal within 2-6 hours depending on satellite geometry providing an adequate margin for detection and localization.</p> <p>Doesn't include C/S T.001 (Nov 88) requirement that operating life be permanently marked on beacon.</p>
2. Transmitter Operating Frequencies	<p>Para 2.2.2.1 Requires transmitter to operate simultaneously on 121.5 and 243.0 MHz $\pm 0.005\%$.</p>	<p>Para 2.2.2.1 Requires frequency to be set initially at 406.025 MHz ± 2 kHz.</p>	0	

¹Improvement Factor:

0 = No Improvement;

+ = Improvement;

S+ = System Improvement;

N/A = Can't be Compared

A. PERFORMANCE REQUIREMENTS (cont.)

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F. ¹	COMMENTS
3. Frequency Stability	Para 2.2.2.1 Requires stability to be within $\pm 0.005\%$ under all environmental conditions.	Para 2.2.2.1, Table 2-4 Short Term: ≤ 0.002 Parts/million in 100 ms. Medium Term (15 min): Mean slope: ≤ 0.001 parts/million/min. Residual: ≤ 0.003 parts/million. Long Term: ± 0.005 MHz within 5 years, including initial offset.	S+	More demanding frequency tolerances should result in greater system location accuracy, typically 1 - 2 km versus 15 - 20 km.
4. Peak Effective Radiated Power	Para 2.2.2.5 Reference 2.3.1.1 & 2.3.1.2 Requires the ELT to meet one of the following power/time combinations: (a) at least 50 mW (17dBm) over a 50 hour period. (b) at least 25 mW (14dBm) over a 100 hour period. (c) not less than any linearly extrapolated power level vs. time period between (a) and (b) above. In addition to (a), (b), or (c) above, the ELT may operate over a 50 hour period at -40° C with a PERP of at least 5 mW (7dBm).	Para 2.2.2.4 (Output Power) Para 2.2.2.5 (VSWR) Para 2.2.2.7 (Spurious Emissions) Reference Figure 2-4 Requires output power to be within limits of 5 watts ± 2 dB measured into a 30-ohm load with a VSWR $\leq 1.25 : 1$. Output power rise time shall not be less than 5 ms measured between 10% and 90% power points. Modulator and transmitter shall be able to meet all requirements except for output power at any VSWR between 1:1 and 3:1 and shall not be damaged by any load from an open circuit to a short circuit. Transmitter power output spectrum should remain within limits of Figure 2-4.	0	

¹Improvement Factor: 0 = No Improvement; + = Improvement; S+ = System Improvement; N/A = Can't be Compared

A. PERFORMANCE REQUIREMENTS (cont.)

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F. ¹	COMMENTS
4. Peak Effective Radiated Power (cont.)	Para 2.2.9 (Transmitter Turn-on) Reference 2.2.2.3 Requires that within 5 minutes of activation (auto or manual), the PERP shall be at least 50 mW (17 dBm) or that selected by the manufacturer.	Para 2.2.8 (Warm-up Time) Requires ELT to be capable of meeting all performance requirements within 15 minutes of activation.	0	Longer warm-up time for 406 beacon (15 minutes vs. 5 minutes) increases probability that the unit will function in extreme environments without significantly lengthening the period between activation and reaching full power.
5. Transmitter Modulation Characteristics	Para 2.2.2.2 (Audio Swept Tone) Requires emission to be type A9, having a distinct audio characteristic achieved by amplitude modulating the carrier with an audio frequency, sweeping downward over a range of not less than 700 Hz, within the range 1600 to 300 Hz, and with a sweep repetition rate between 2 and 4 Hz. The modulation factor shall be at least 0.85. Allows optional characteristics to improve SAR capabilities: (a) SAR Detection and Homing Capabilities - a burst of unmodulated CW power for a duration of 2.0 \pm 0.25 seconds and repeat the burst every 8.0 \pm 0.25 seconds. (cont. on next page)	Para 2.2.2.2 (Digital Message) Requires digital message generator to key modulator and transmitter with a repetition period of 50 seconds \pm 5% (so that any two transmitters will not appear to be synchronized closer than a few seconds over a 5 minute period) and a total transmission time of 440 ms \pm 1 percent (short message) or 520 ms \pm 1 percent (long message). The initial 160 ms \pm 1 percent of transmitted signal shall be an unmodulated carrier at the transmitter frequency (measured at the 90% power point); the final 280 ms \pm 1 percent of transmitted signal shall contain 112 bit message at rate of 400 bps \pm 1 percent (short message); (cont. on next page)	S+	Identification and global coverage enable early commencement of a SAR mission. DO-204 incorporates all requirements of C/S T.001 (Nov 88).

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A. PERFORMANCE REQUIREMENTS (cont.)

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F. ¹	COMMENTS
5. Transmitter Modulation Characteristics (cont.)	<p>Para 2.2.2.2 (Audio Swept Tone) (cont.)</p> <p>(b) SAR Satellite Detection - provide clearly defined carrier with at least 30% of power within ± 30 Hz of the carrier at 121.5 Mhz and ± 60 Hz at 243.0 MHz.</p> <p>(c) Voice Modulation (A3) - is allowable provided it will not consume energy from the power supply at rate greater than normal ELT swept tone modulation (A9).</p>	<p>Para 2.2.2.2 (Digital Message) (cont.)</p> <p>the final 360 ms ± 1 percent of transmitted signal shall contain 144 bit message at rate of 400 bps ± 1 percent (long message). Requires bit synch pattern ("1's") to occupy first 15 bit positions. Requires frame synch pattern ("0 0010 1111"-normal or "0 1101 0000"-test) to occupy positions 16 through 24. Frame flag will be bit 25 ("0"-short message, "1"- long message), and remaining 87 bits (short message) or 119 bits (long message) are defined in C/S documents.</p>		
6. Modulation Duty Cycle	<p>Para 2.2.2.3</p> <p>Requires modulation applied to carrier to have a minimum duty cycle of 33% and a maximum duty cycle of 55%. Emission designator is A9.</p>	<p>Para 2.2.2.3</p> <p>Requires the carrier to be phase modulated 1.1 ± 0.1 radians peak referenced to the unmodulated carrier. Rise and fall times of modulated waveform are required to be 150 microseconds ± 100 microseconds. Emission designator is 16K0G1d.</p>	N/A	Although the very short duty cycle ($\approx 1\%$) of the 406 MHz transmission is not well suited to homing by aircraft, the beacon will be carried in conjunction with a 121.5/243.0 beacon.

¹Improvement Factor:

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+ = Improvement;

S+ = System Improvement;

N/A = Can't be Compared

A. PERFORMANCE REQUIREMENTS (cont.)

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F. ¹	COMMENTS
7. Transmitter Duty Cycle	Para 2.2.2.3 Reference 2.2.2.2 Requires the transmission to not be interrupted, except as specified in para 2.2.2.2.	Para 2.2.2.2 Para 2.2.2.6 (Max Continuous Transmission) Requires repetition period of 47.5 to 52.5 seconds. Inadvertent continuous transmission be equipment failure shall be limited to a maximum of 45 seconds.	N/A	
8. Antenna Radiation Characteristics	Para 2.2.4 Requires that both the fixed and auxiliary antennas (if provided) shall radiate on 121.5 and 243.0 MHz. Radiation shall be vertically polarized and omni-directional in the horizontal plane, but only when the antenna is in its normal orientation.	Para 2.2.4 Allows circular (RHCP) or linear polarity. Requires antenna gain (antenna in normal mounting configuration and on ground plane of 1/2 wave-length radius) to be between -3 dBi and +4 dBi over 90% of following range: Azimuth: full 360° Elevation: 5° < elevation < 60°	0	Incorporates all requirements of C/S T.001 (Nov 88).

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A. PERFORMANCE REQUIREMENTS (cont.)

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F. ¹	COMMENTS
9. Automatic Crash Activation of Sensor	<p>Para 2.2.3 Reference Figure 2-1 Requires the crash activation sensor to activate with a threshold force level of 2.0 ± 0.3 G's and a minimum velocity change of 3.5 ± 0.5 ft/sec (but not under less severe conditions) and when simultaneously subjected to 30 G's of cross-axis acceleration.</p>	<p>Para 2.2.3 Reference Figure 1-1 Same as DO-183</p>	0	Carries DO-183 requirements forward, providing significant improvement to crash sensor which should yield an increase in number of crashes detected and a corresponding decrease in non-crash activations.
	<p>Para 2.2.3c (Sensor Packaging) Reference 2.2.1 Requires, if the sensor is packaged as a separate unit, that no combination of short circuits and/or open circuits in the interconnecting wiring shall result in a reduction of operating life or in deactivation of the transmitter after it has been activated.</p>	<p>Para 2.2.3b Same as DO-183</p>	0	

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A. PERFORMANCE REQUIREMENTS (cont.)

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F. ¹	COMMENTS
9. Automatic Crash Activation of Sensor (cont.)	<p>Para 2.2.3d (Crash Sensor/ELT Interface) Requires, if a separate unit is used, that the interface wiring is not required to survive the crash after it transmits the activation signal. Disconnecting the interface for maintenance shall not cause a false activation.</p>	<p>Para 2.2.3c Same as DO-183</p>	0	
	<p>Para 2.2.3e (Optical Sensors) Reference 2.2.3b & 2.2.1 Allows optional alternate crash sensors, and requires that switches must be mounted in sufficient numbers and locations to detect a crash as describe in 2.2.3b. Using operational parameters, such as engine pressure or engine vacuum to indicate crash situations is another acceptable method provided that ELT activation shall not occur during normal operational procedures and special action on the part of the pilot to disarm the device at the end of the flight is not required.</p>	<p>Para 2.2.3d Reference 2.2.3a Same as DO-183</p>	0	Carries forward provision for alternate crash sensors with caveat that they not activate during normal operations and not require pilot action to disarm device at end of flight.

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A. PERFORMANCE REQUIREMENTS (cont.)

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F. ¹	COMMENTS
10. Activation Monitor and Remote Control	Para 2.2.6 a & b Requires an aural and/or visual monitor (integral or separate from the ELT) to alert the pilot to the fact that the ELT has been activated and is transmitting. The aural monitor if not integral to the ELT must be installed in the aircraft and must have a minimum signal intensity level of 90 dBm measured 1 meter from the source. The visual monitor must be in view of the pilot's position, and it shall be visible under normal daytime ambient light conditions at 1 meter. Remote controls shall be provided if the local controls are not accessible from the pilot's position.	Para 2.2.6 a & b Requires both an aural and visual monitor to alert the pilot to the fact that the ELT has been activated. The aural monitor shall provide a distinct signal with a minimum intensity of 75 Dbm but not exceeding 85 Dbm at the pilot's position, and is required to operate when the aircraft's primary electrical system is "OFF". The visual monitor must be operable at all times and must be visible from the pilot's position under normal daytime ambient light conditions.	+	Aural and visual monitors are required with specific operational periods, improving pilot and ground crew capability to detect inadvertent transmitter operation.

¹Improvement Factor:

0 = No Improvement;

+ = Improvement;

S+ = System Improvement;

N/A = Can't be Compared

A. PERFORMANCE REQUIREMENTS (cont.)

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F. ¹	COMMENTS
10. Activation Monitor and Remote Control (cont.)	<p>Para 2.2.6c For both monitors, the remote control mode will be Manual On, Armed, and Reset. Off will not be available.</p> <p>Further requires that the power supply, either a dedicated or alternate power supply, may not detract from the ELT operating life. For fault tolerance, no combination of short circuits between the remote control, monitor(s), associated wiring and the airframe shall either inhibit the equipment from being automatically activated, or deactivated, or cause a power drain.</p>	<p>Para 2.2.6c Same as DO-183.</p>	0	Remote control requirements of DO-183 are carried forward enhancing potential for pre-flight detection that ELT is not armed. Facilitates ground crew deactivation of inadvertent ELT transmissions when ELT is not located in the cockpit area.
11. Power Supply	<p>Para 2.1.11 Requires that gas or liquid seepage from power supply shall not effect internal ELT components (separation of battery compartment from electronics within ELT case).</p>	<p>Para 2.1.12 (Battery) Requires that ELT not be hazardous to personnel and that toxic or corrosive products not be released outside the case during or following storage at temperatures between -55° C and +85° C. If fluids can be vented, they must be contained so that they shall not effect internal ELT components.</p>	+	Prevents corrosion electronics due to fluid leakage. Enhances safety of personnel handling or servicing ELTs.

¹Improvement Factor:

0 = No Improvement;

+ = Improvement;

S+ = System Improvement;

N/A = Can't be Compared

A. PERFORMANCE REQUIREMENTS (cont.)

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F.¹	COMMENTS
12. Self Test	Not Addressed	<p>Para 2.1.9 The ELT shall include a self test designed to test, as a minimum, the capability of the battery to power the unit and to activate the cockpit ELT monitor. Any modulated signal transmitted from the ELT during the self test shall have a special frame synchronization pattern and shall not transmit more than one burst to ensure that the signal is not processed by the satellites.</p>	+	<p>Adds requirement for a self test capability which will adequately test the ELT and not generate a false alarm position.</p>

¹Improvement Factor: 0 = No Improvement; + = Improvement; S+ = System Improvement; N/A = Can't be Compared

B. CRASHWORTHINESS

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F. ¹	COMMENTS
1. Shock Impulse Survival Level	Para 2.3.4.1 Requires that ELT must survive 1 shock impulse of 500 G's (4 ± 1 ms duration) in each of six directions. This impulse is based on aircraft impact velocities of 190 mph.	Para 2.3.4.1 Reference 2.4.2.4 Requires that ELT be operating and that ELT must continue to operate following a shock impulse of 500 G's (4.0 ± 1.0 ms duration) in each of six directions and then continue to operate following a shock pulse of 100 G's with a duration of 23.0 ± 2.0 ms.	+	Adds requirement for ELT to be operating during test and adds second test at 100 G's. Should significantly improve ELT survival following a crash.
2. System Integrity Associated with Crashworthiness	Para 2.2.5 Reference 2.4.2.4 Requires that attachment and/or mounting normally used to mount the ELT in the aircraft shall withstand a shock test of 100 G's in all directions in the non-operating mode without the ELT breaking loose, damaging the equipment, or otherwise resulting in the ELT's not being able to activate.	Para 2.2.5 Reference 2.4.2.4 Same as DO-183	0	Improves survivability of ELT in its mount.

¹Improvement Factor: 0 = No Improvement; + = Improvement; S+ = System Improvement; N/A = Can't be Compared

B. CRASHWORTHINESS (cont.)

SPECIFICATION REQUIREMENT	RTCA/DO-183 (MAY 1983)	RTCA/DO-204 (SEP 1989)	I. F. ¹	COMMENTS
3. Crash Protruding Survivability	Para 2.3.4.2 Requires that ELT withstand a drop of 25 kg (55 lb) mass with a penetrator of 0.64 cm (0.25 in) x 2.5 cm (1 in) from a height of 15 cm (6 in) on the most vulnerable area of three or four required areas of the ELT.	Para 2.3.4.2 Requires that ELT be operating during test and that ELT continue to operate following test. Actual test requirements/procedures are same as DO-183.	+	Requirement for ELT to be operating during test is more restrictive than DO-183 and should result in a more survivable ELT.
4. Crash Pressure Survivability	Para 2.3.4.3 Requires that ELT must withstand a crushing pressure of 6.9×10^5 newtons per m^2 (100 psi) not to exceed 450 kg (1000lb) successively over three or four required surface areas of the ELT.	Para 2.3.4.3 Requires that ELT be operating during test and that ELT continue to operate following test. Actual test requirements/procedures are same as DO-183.	+	Requirement for ELT to be operating during test is more restrictive than DO-183 and should result in a more survivable ELT.
5. Antenna and Coaxial Cable	Para 3.1.10 & 3.1.11 Provides specific requirements for antenna polarization (vertical); proximity of externally mounted antenna to ELT (3.1.10.2); static load test of 100 x weight (3.1.10.3); internal antenna installation (3.1.10.4); and cable installation (3.1.11) requiring slack in cable, application of fires resistant material around cable, and prohibiting cable installation across aircraft production breaks.	Para 3.1.10 & 3.1.11 Same as DO-183 with exception of antenna polarization which can be either circular (RHCP) or linear.	0	Provides greater potential for antenna and interconnecting cables to survive a crash.

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0 = No Improvement;

+ = Improvement;

S+ = System Improvement;

N/A = Can't be Compared